DIURNAL AND TEMPORAL VARIATION OF UV-FLUX AND ITS DEPENDENCE ON STRATOSPHERIC OZONE

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ABSTRACT

As part of Indian Middle Atmospheric Programme, global UV-B flux is measured regularly at Mysore (12°N, 76°E). The results of a preliminary analysis on the variation of UV-B flux with atmospheric ozone for the period April-May 1987 are presented in this paper.

EXPERIMENTAL SETUP

The UV-B Photometer radiometer is designed to measure the global (sum of direct and diffuse radiations) UV-B flux at four wavelengths 280, 290, 300 and 310 nm. The photometer system was designed and fabricated at the National Physical Laboratory, New Delhi. The system is made up of three units:

1. Radiometer unit consisting of an integrating sphere, filter wheel and photomultiplier (PM) tube.

2. A high voltage power supply to provide highly regulated 0-1200 VDC for operating the PM tube.

3. Data logger with printer for recording the output signal from the PM tube.

The system was calibrated using the UV-spectroradiometer model 742 of Optronics Laboratories, USA to convert the photometer output(mV) into absolute flux ($W/cm^2/nm$). Photometer filters were found to have the maximum transmission at 283, 295, 303 and 319 nm.

RESULTS

The results reported here are based on the analysis of the UV-B data collected at Mysore during the months April-May 1987. Clear sky conditions generally prevail during this period of the year. Figure 1 shows a typical diurnal variation of global UV-flux at 280 and 300 nm. The ground reaching UV-flux is maximum at local noon (approx. 1220 hrs IST). The noon solar zenith distance reaches overhead position on 23 April and changes to about 11° on 12 June. Five day running average of the noon UV-flux shows a trend which follows closely the solar altitude and exhibits a periodic behaviour (Fig. 2). Power spectral analysis of this noon UV-B shows a periodicity of 12 days. Similar periodicity seen in the trace gas mixing ratios during MAP/GLOBUS 1983 campaign has

been interpreted in terms of horizontal and vertical transport of trace gases (OFFERMAN et al. 1987).

Ozone values (DU) are measured regularly at Kodaikanal (10°N, 77°E) by the India Meteorology Department from Dobson spectrophotometer. Figure 3 shows the temporal variations of ozone and UV-B flux at 290 nm at χ=60°. Similar trend is seen with the ozone and UV-flux at other times of the day. An examination of Fig.3 shows the well known trend in UV-B flux decrease with increase in stratospheric ozone. It is observed that a 3 percent increase in ozone results in a 35 percent decrease in the UV-B flux (global) measured at Mysore. This is much larger than the values computed theoretically (DAVE and HALPERN, 1976). Similar results have been found in the UV-B flux measurements at Delhi (SRIVASTAVA et al. 1984).

Table 1 gives the UV-B flux for April 15 and May 15 at different solar zenith angles.

Table 1: UV-B flux ($W/cm^2/nm$)

		Solar zenith angle			
λnm	Date	noon	20°	40°	60°
280	April 15	3.4(-10)	2.7(-10)	1.65(-10)	0.7(-10)
	May 15	2.3(-10)	2.15(-10)	1.2(-10)	0.52(-10)
290	April 15	1.9(-10)	9.8(-9)	5.2(-9)	2.4(-9)
	May 15	9.2(-9)	8.2(-9)	4.5(-9)	1.85(-9)
300	April 15	5.8(-7)	5(-7)	2.5(-7)	1.1(-7)
	May 15	4.6(-7)	3.9(-7)	2.0(-7)	0.84(-7)
310	April 15	5.6(-6)	4.3(-6)	2.2(-6)	1.0(-6)
	May 15	4.7(-6)	4(-6)	2.05(-6)	0.88(-6)

Read 1(-10) = 1×10^{-10}

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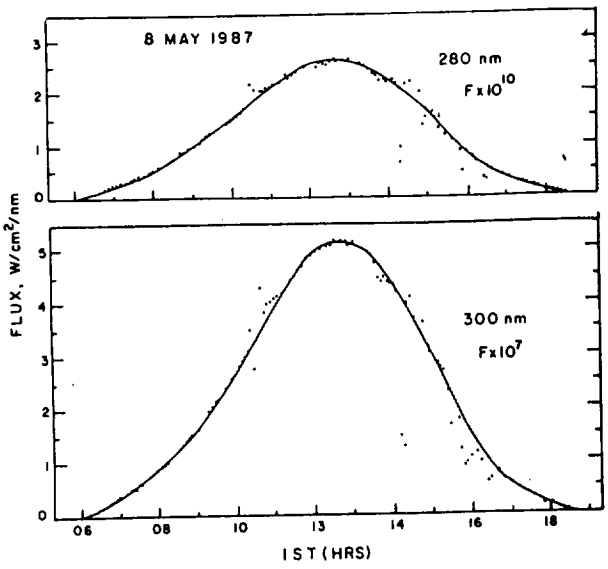

Figure 1. Diurnal variation of UV - B flux at 280 and 290 nm.

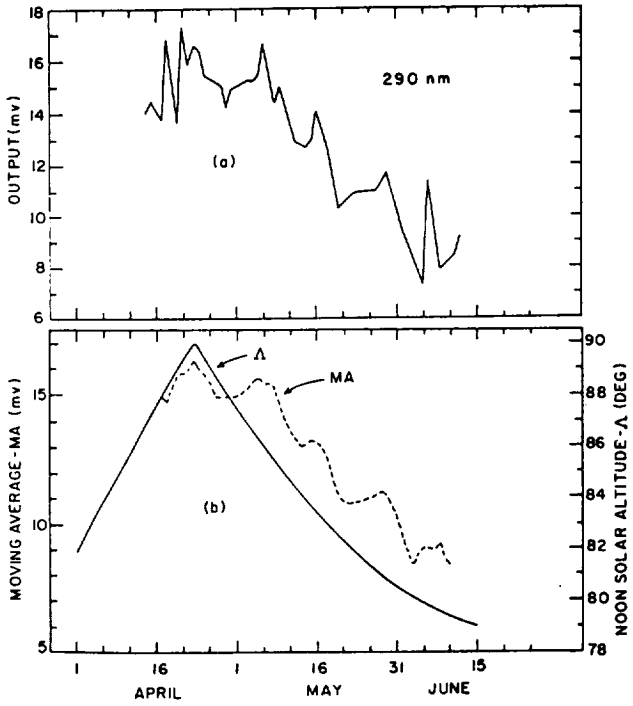

Figure 2 (a). Time series of noon UV - B flux data at 290nm.
(b). 5 day moving average (MA) of the UV - B flux and the noon solar altitude for May - June 1987.

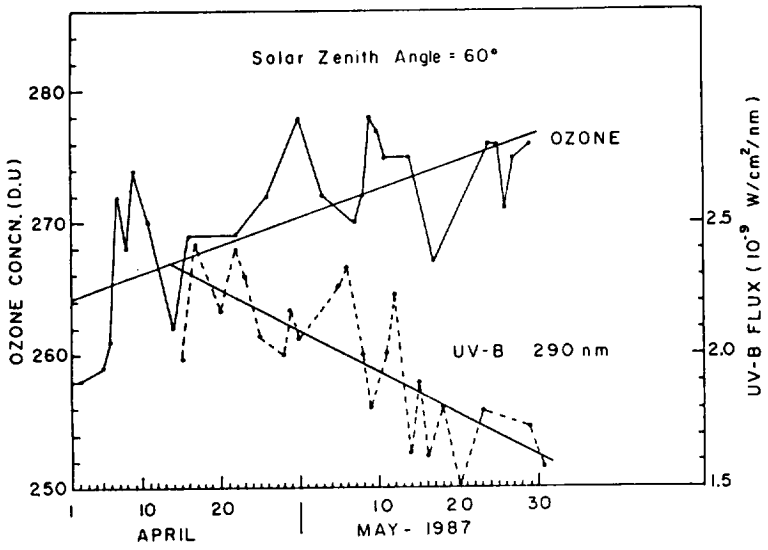

Figure 3. Temporal variation of ozone concentration and UV - B flux at 290 nm for $\chi = 60^{\circ}$.